CLAIMS:

1. An underfill composition comprising:

a first curable transparent resin composition comprising an aromatic epoxy resin in combination with a solvent, a functionalized colloidal silica dispersion, and at least one other component selected from the group consisting of cycloaliphatic epoxy monomers, aliphatic epoxy monomers, hydroxy aromatic compounds and combinations and mixtures thereof; and

a second curable fluxing composition comprising at least one epoxy resin.

2. The underfill composition of claim 1, wherein the first curable transparent resin further comprises at least one resin selected from the group consisting of epoxy resins, acrylate resins, polyimide resins, fluorocarbon resins, fluororesins, benzocyclobutene resins, bismaleimide triazine resins, fluorinated polyallyl ethers, polyamide resins, polyimidoamide resins, phenol cresol resins, aromatic polyester resins, polyphenylene ether resins and polydimethyl siloxane resins.

3. The underfill composition of claim 1, wherein the first curable transparent resin further comprises at least one silicone-epoxy resin.

4. The underfill composition of claim 1, wherein the aromatic epoxy resin is a cresol novolac epoxy.

5. The underfill composition of claim 1, wherein the cycloaliphatic epoxy monomer is selected from the group consisting of 3-cyclohexenylmethyl-3-cyclohexenylcarboxylate diepoxide, 3-(1,2-epoxyethyl)-7-oxabicycloheptane, hexanedioic acid, bis(7-oxabicyclo hept-ylmethyl) ester, 2-(7-oxabicyclohept-3-yl)-spiro(1,3-dioxa-5,3'-(7)-oxabicycloheptane, and methyl 3,4-epoxycyclohexane carboxylate.

6. The underfill composition of claim 1, wherein the aliphatic epoxy monomer is selected from the group consisting of butadiene dioxide, dimethylpentane dioxide, diglycidyl ether, 1, 4-butanedioldiglycidyl ether, diethylene glycol diglycidyl ether, and dipentene dioxide.

7. The underfill composition of claim 1, wherein the colloidal silica has a particle size of between about 20 nm and about 100 nm.

8. The underfill composition of claim 7, wherein the colloidal silica has a particle size of between about 50 and about 75 nm.

9. The underfill composition of claim 1 further comprising at least one resin hardener.

10. The underfill composition of claim 9 wherein the at least one resin hardener is selected from the group consisting of phenol novolac resin hardeners, hydroquinone, resorcinol, and combinations and mixtures thereof.

11. The underfill composition of claim 1, wherein the at least one solvent is selected from the group consisting of 1-methoxy-2-propanol, butyl acetate, methoxyethyl ether, methoxy propanol acetate and methanol.

12. The underfill composition of claim 1, wherein the colloidal silica is functionalized with at least one organoalkoxysilane.

13. The underfill composition of claim 12, wherein the colloidal silica is functionalized with phenyl trimethoxysilane.

14. The underfill composition of claim 12 wherein the colloidal silica is endcapped by a silylating agent.

15. The underfill composition of claim 14, wherein the silylating agent is hexamethyldisilazane.

16. The underfill composition of claim 1, wherein the filler of colloidal silica further comprises silicon dioxide in an amount ranging from about 15 weight percent to about 75 weight percent of the composition.

17. The underfill composition of claim 1, further comprising a catalyst selected from the group consisting of triphenyl phosphine, N-methylimidazole, and butyl tin dilaurate.

18. The underfill composition of claim 1, wherein the first curable transparent resin composition further comprises additives selected from the group consisting of flame retardants, adhesion promoters, reactive organic diluents, curing agents, and combinations thereof.

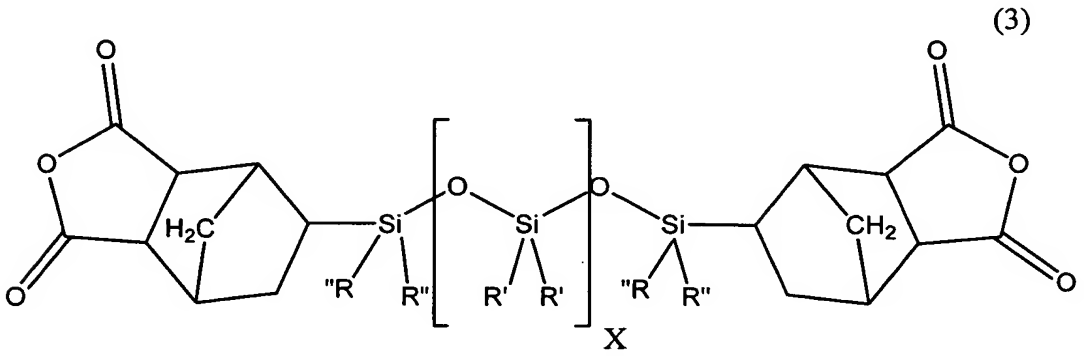
19. The underfill composition of claim 18, wherein said reactive organic diluent comprises a monofunctional epoxy.

20. The underfill composition of claim 1, wherein the at least one epoxy resin of the second curable fluxing composition is selected from the group consisting of 3-cyclohexenylmethyl-3-cyclohexenylcarboxylate diepoxide, bisphenol-F epoxy, bisphenol-A epoxy, and combinations thereof.

21. The underfill composition of claim 1, wherein the second curable fluxing composition further comprises at least one epoxy hardener.

22. The underfill composition of claim 21, wherein the at least one epoxy hardener is selected from the group consisting of amine epoxy hardeners, phenolic resins, carboxylic acid-anhydrides, novolac hardeners, and difunctional siloxane anhydrides.

23. The underfill composition of claim 21, wherein the at least one epoxy hardener comprises a difunctional siloxane anhydride of the formula:



where X is from 0 to 50 inclusive, and each R' and R" are independently selected from the group consisting of C_{1-22} alkyl, C_{1-22} alkoxy, C_{2-22} alkenyl, C_{6-14} aryl, C_{6-22} alkyl-substituted aryl, and C_{6-22} arylalkyl.

24. The underfill composition of claim 23, wherein the at least one difunctional siloxane anhydride comprises a mixture of oligomers of formula (3) and wherein X in formula (3) is from 0 to 10 inclusive.

25. The underfill composition of claim 23, further comprising at least one anhydride epoxy hardener selected from the group consisting of methylhexahydrophthalic anhydride (MHHPA), methyltetrahydrophthalic anhydride, 1,2-cyclohexanedicarboxylic anhydride, bicyclo[2.2.1]hept-5-ene-2,3-dicarboxylic anhydride, methylbicyclo[2.2.1]hept-5-ene-2,3-dicarboxylic anhydride, phthalic anhydride, pyromellitic dianhydride, hexahydrophthalic anhydride, dodecenylsuccinic anhydride, dichloromaleic anhydride, chlorendic anhydride, tetrachlorophthalic anhydride, and mixtures thereof.

26. The underfill composition of claim 23, further comprising a liquid epoxy hardener selected from the group consisting of methylhexahydrophthalic anhydride, hexahydrophthalic anhydride, and tetrahydrophthalic anhydride.

27. The underfill composition of claim 1, wherein the second curable fluxing composition further comprises a colloidal silica dispersion functionalized with at least one organoalkoxysilane.

28. The underfill composition of claim 27, wherein the colloidal silica has a particle size of between about 5 nm and about 200 nm.

29. An underfill composition comprising

a first curable transparent resin composition comprising at least one aromatic epoxy resin in combination with at least one solvent, a functionalized colloidal silica dispersion having a particle size of about 50 nm to about 100 nm, and at least one additional component selected from the group consisting of cycloaliphatic epoxy monomers, aliphatic epoxy monomers, hydroxy aromatic compounds, and combinations and mixtures thereof; and

a second curable fluxing composition comprising at least one epoxy resin in combination with at least one epoxy hardener.

30. The underfill composition of claim 29, wherein the aromatic epoxy resin comprises a cresol novolac epoxy resin.

31. The underfill composition of claim 30, wherein the aromatic epoxy resin further comprises a novolac hardener.

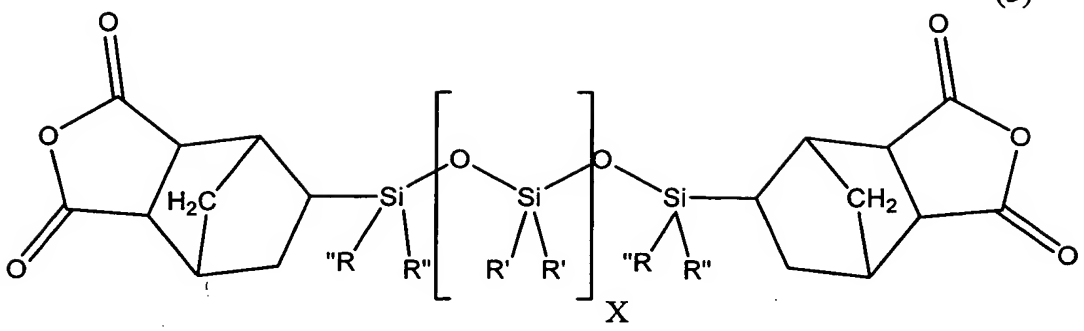
32. The underfill composition of claim 29, wherein the at least one solvent is 1-methoxy-2-propanol.

33. The underfill composition of claim 29, wherein the first curable transparent resin composition further comprises a catalyst selected from the group consisting of triphenyl phosphine, N-methylimidazole, and butyl tin dilaurate.

34. The underfill composition of claim 29, wherein the functionalized colloidal silica comprises silicon dioxide in the range of about 15 weight percent to about 75 weight percent of the functionalized colloidal silica dispersion.

35. The underfill composition of claim 29, wherein the at least one epoxy hardener comprises a difunctional siloxane anhydride of the formula:

(3)



where X is from 0 to 50 inclusive, and each R' and R" are independently selected from the group consisting of C_{1-22} alkyl, C_{1-22} alkoxy, C_{2-22} alkenyl, C_{6-14} aryl, C_{6-22} alkyl-substituted aryl, and C_{6-22} arylalkyl.

36. The underfill composition of claim 35, wherein the at least one difunctional siloxane anhydride comprises a mixture of oligomers of formula (3) and wherein X in formula (3) is from 0 to 10 inclusive.

37. The underfill composition of claim 35, further comprising at least one anhydride epoxy hardener selected from the group consisting of methylhexahydrophthalic anhydride (MHHPA), methyltetrahydrophthalic anhydride, 1,2-cyclohexanedicarboxylic anhydride, bicyclo[2.2.1]hept-5-ene-2,3-dicarboxylic anhydride, methylbicyclo[2.2.1]hept-5-ene-2,3-dicarboxylic anhydride, phthalic anhydride, pyromellitic dianhydride, hexahydrophthalic anhydride, dodecenylsuccinic anhydride, dichloromaleic anhydride, chlorendic anhydride, tetrachlorophthalic anhydride, and mixtures thereof.

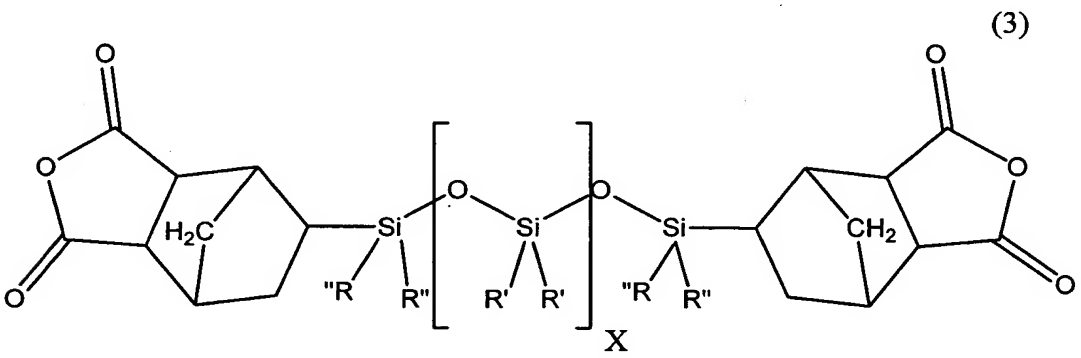
38. The underfill composition of claim 35, further comprising a liquid epoxy hardener selected from the group consisting of methylhexahydrophthalic anhydride, hexahydrophthalic anhydride, and tetrahydrophthalic anhydride.

39. The underfill composition of claim 29, wherein the second curable fluxing composition further comprises a functionalized colloidal silica dispersion having a particle size of between about 5 nm and about 200 nm, wherein said colloidal silica is functionalized with at least one organoalkoxysilane.

40. An underfill composition comprising

a first curable transparent epoxy resin comprising a cresol novolac epoxy resin in combination with at least one solvent, a functionalized colloidal silica dispersion having a particle size of about 50 nm to about 100 nm, and at least one additional component selected from the group consisting of cycloaliphatic epoxy monomers, aliphatic epoxy monomers, hydroxy aromatic compounds, and combinations and mixtures thereof; and

a second curable fluxing composition comprising at least one epoxy resin in combination with at least one difunctional siloxane anhydride epoxy hardener of the formula:



where X is from 0 to 50 inclusive, and each R' and R" are independently selected from the group consisting of C_{1-22} alkyl, C_{1-22} alkoxy, C_{2-22} alkenyl, C_{6-14} aryl, C_{6-22} alkyl-substituted aryl, and C_{6-22} arylalkyl.

41. A solid state device comprising:

a chip;

a substrate; and

an underfill composition between the chip and the substrate comprising a first curable transparent resin composition comprising at least one aromatic epoxy resin in combination with at least one solvent, a functionalized colloidal silica dispersion having a particle size of about 50 nm to about 100 nm, and at least one additional component selected from the group consisting of cycloaliphatic epoxy

monomers, aliphatic epoxy monomers, hydroxy aromatic compounds and combinations and mixtures thereof; and

a second curable fluxing composition comprising at least one epoxy resin in combination with at least one epoxy hardener.

42. The solid state device of claim 41, wherein the at least one epoxy hardener comprises a difunctional siloxane anhydride epoxy hardener of the formula:

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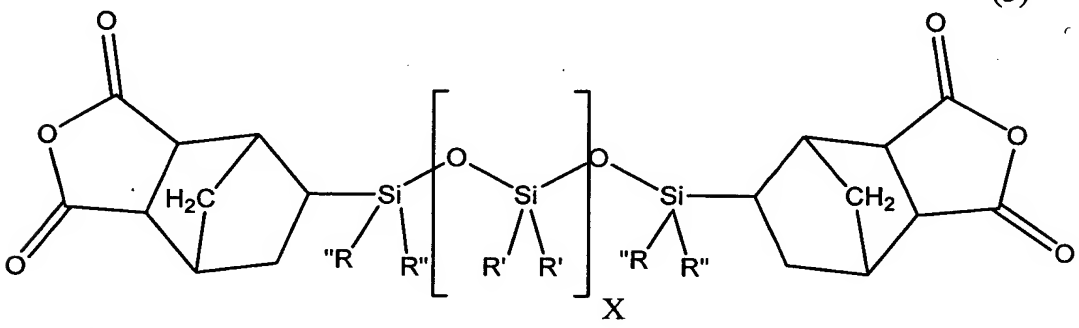

where X is from 0 to 50 inclusive, and each R' and R" are independently selected from the group consisting of C_{1-22} alkyl, C_{1-22} alkoxy, C_{2-22} alkenyl, C_{6-14} aryl, C_{6-22} alkyl-substituted aryl, and C_{6-22} arylalkyl.

43. The solid state device of claim 42, further comprising at least one anhydride epoxy hardener selected from the group consisting of methylhexahydrophthalic anhydride (MHHPA), methyltetrahydrophthalic anhydride, 1,2-cyclohexanedicarboxylic anhydride, bicyclo[2.2.1]hept-5-ene-2,3-dicarboxylic anhydride, methylbicyclo[2.2.1]hept-5-ene-2,3-dicarboxylic anhydride, phthalic anhydride, pyromellitic dianhydride, hexahydrophthalic anhydride, dodecenylsuccinic anhydride, dichloromaleic anhydride, chlorendic anhydride, tetrachlorophthalic anhydride, and mixtures thereof.

44. The solid state device of claim 42, further comprising a liquid epoxy hardener selected from the group consisting of methylhexahydrophthalic anhydride, hexahydrophthalic anhydride, and tetrahydrophthalic anhydride.

45. The solid state device of claim 41, wherein the transparent underfill composition further comprises additives selected from the group consisting of resin hardeners, resin catalysts, flame retardants, adhesion promoters, reactive organic diluents, curing agents, and combinations thereof.

46. A method for producing a solid state device comprising:

applying to a chip a first curable transparent resin composition comprising an aromatic epoxy resin in combination with a solvent, a functionalized colloidal silica dispersion, and at least one other component selected from the group consisting of cycloaliphatic epoxy monomers, aliphatic epoxy monomers, hydroxy aromatic compounds and combinations and mixtures thereof, to produce a coated chip;

applying a second curable fluxing composition comprising at least one epoxy resin in combination with at least one epoxy hardener to a substrate;

placing the coated chip on a portion of the substrate to which the fluxing composition has been applied; and

curing the first curable transparent resin composition and second curable fluxing composition to form an underfill composition.

47. The method of claim 46 wherein the step of applying the first curable transparent resin composition further comprises applying a first curable transparent resin having colloidal silica possessing a particle size of between about 20 nm and about 100 nm.

48. The method of claim 46 wherein the step of applying the first curable transparent resin composition further comprises removing the solvent to form a hard, transparent B-stage resin film on the chip.

49. The method of claim 46 wherein the step of applying the second curable fluxing composition to the substrate further comprises applying an

epoxy resin in combination with at least one epoxy hardener comprising a difunctional siloxane anhydride of the formula:

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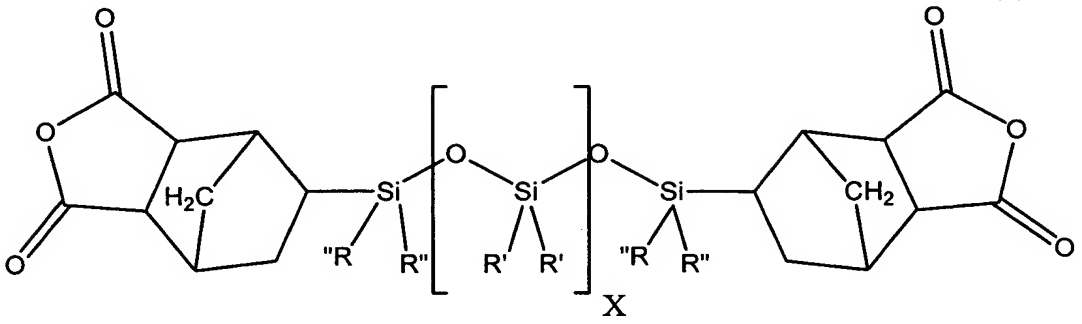

where X is from 0 to 50 inclusive, and each R' and R" are independently selected from the group consisting of C_{1-22} alkyl, C_{1-22} alkoxy, C_{2-22} alkenyl, C_{6-14} aryl, C_{6-22} alkyl-substituted aryl, and C_{6-22} arylalkyl.

50. The method of claim 46 wherein the step of applying the second curable fluxing composition to the substrate comprises applying a second curable fluxing composition which further comprises a colloidal silica dispersion functionalized with at least one organoalkoxysilane and having a particle size of between about 5 nm and about 200 nm.